

REMARKS

The Office Action of May 15, 2003 presents the examination of claims 1-19, 21 and 34-36, claims 23-33 standing withdrawn from consideration. The withdrawn claims are canceled herein. Applicants reserve the right to file an application directed to the canceled subject matter pursuant to 35 USC § 120.

Formal objections

The Examiner objects to claims 35, suggesting "viologen-salt" for "viologen" and 36, suggesting "vinyl benzyl halide" for "vinyl benzyl". These amendments are made herein.

Rejection under 35 USC § 112, second paragraph

The Examiner rejects claims 1-19, 21, 23, 34 and 35 under 35 USC § 112, second paragraph, asserting that the terms, "pre-doped" and "doping" render these claims indefinite. This rejection is respectfully traversed. Reconsideration and withdrawal thereof are requested.

The Examiner takes a position that the terms "doping" and "pre-doped" somehow limit the claims with respect to the amount of some material used for doping. This interpretation of the claims is incorrect. It is perfectly clear from the specification and the art as a whole that the term doping refers to the addition of some charge carrier, either electrons, ions or holes, to a material. In

the present invention, this is accomplished by the method steps recited in the claims. The adjective "pre-doped" merely describes the state of the composition before the doping is accomplished upon irradiation. This is clear to the skilled artisan who reads, e.g. claim 1. "Doping" (actually "oxidative doping") describes a process applied to the material by step b) of claim 1 and limits the material used in step a) to one that will give the desired result. The "doping" process as recited in the claims is well-described in the specification at, e.g. page 3, lines 8-12 and at page 7, lines 10-14.

Applicants submit that the terms "pre-doped" and "doping" are perfectly clear to the skilled artisan in view of the specification as explained above. Accordingly, the instant rejection should be withdrawn.

Rejections over prior art

The Examiner has maintained the following rejections under 35 USC § 103(a) from the previous Office Action:

Claims 1, 2, 10, 11 and 17 over Mikhael '017 in view of Porter '621;

Claims 1, 2, 7-11, 15, 17-19 over Afzali-Ardakani '370 in view of Porter '621 and Renbaum '055;

Claims 3-6 and 35 over Afzali-Ardakani in view of Porter '621, Renbaum '055 and Beratan '063;

Claims 12-14 and 16 over Afzali-Ardakani in view of Porter '621, Renbaum '055 and Inata '062; and

Claims 34 and 21 over Afzali-Ardakani in view of Porter '621, Renbaum '055 and Allemand '379.

Claim 36 is newly rejected under 35 USC § 103(a) as being unpatentable over JP 56026977 in view of Pohl '233, Renbaum '055 and Beratan '063.

All of these rejections are respectfully traversed. Reconsideration and withdrawal thereof are requested.

As to the maintained rejections

Regarding the rejections of claims 1-22 and 34-36 that the Examiner has maintained, Applicants again submit that the Examiner has failed to properly establish *prima facie* obviousness of the claimed invention. Applicants maintain that the Porter reference fails to remedy the fundamental flaw in the rejection that neither Mikhael nor Afzali-Ardakani describes oxidative doping of a polymer by a viologen salt. The logic of the Examiner in explaining how Porter does so is flawed and not tenable.

The Examiner replies to Applicants' position by arguing that Mikhael describes an "electron acceptor dopant" as any electrophilic organic substance that interacts or complexes with any electron-rich organic material. The Examiner further argues that Porter describes both viologen salts and quinones as

sufficiently powerful oxidizing agents to abstract electrons from the excited manganese complex.

The Examiner's reasoning fails because (1) there is no limitation on the polymer to be made conductive upon oxidative doping that it is an electron rich material and (2) there is no "excited manganese complex" involved in the present invention. As to (1), at least in claim 1, there is not any limitation on the polymer other than that oxidation by a viologen salt will make it conductive. There is no limitation that it be "electron-rich" and so Mikhael's definition is irrelevant.

However, it is flaw (2) that is most substantive. Porter describes oxidative splitting of water to make hydrogen and oxygen using a porphyrin-manganese complex imitative of the reaction center of chlorophyll. The quinone and viologen compounds described by Porter are used to oxidize this complex. The Examiner provides no evidence whatsoever that the E_0 of this complex is similar to that of the polymer, e.g. polyaniline, polypyrrole, or derivatives thereof (see claim 17) utilized in the present invention. It may well be the case that quinone and viologen can both be used to oxidize the porphyrin-manganese complex of Porter, but cannot both be used to oxidize a polymer substrate. Thus, Porter does not establish equivalence of quinones and viologen salts for purposes of the present invention and the rejections of

claims 1-22 and 34-36 over the combinations of references including Mikhael or Afzali-Ardakani and Porter must all be withdrawn.

Furthermore, even if these rejections are deemed appropriate as establishing *prima facie* obviousness, the present invention provides a result that is unexpected in view of the cited prior art. In particular, the present invention provides superior conductivity in the resulting polymer material and does so at an accelerated rate compared to the prior art. The Examiner will note that the invention provides reductions in resistance of up to five or six orders of magnitude over the resistance of the base polymer (see e.g., page 4, line 5 and page 12, lines 4 and 12. Furthermore the rate of the decrease is such that it can be achieved in about 3 hours (see, original claim 18). Indeed, the more typical rate is a reduction of up four to six orders of magnitude in less than one hour (see Figure 1). This should be compared to the prior art as represented by Afzali-Ardakani (the only reference of record to report changes in resistance/conductivity), who report an increase in conductivity of about 4 orders of magnitude after 24 hours of doping by protonic acid treatment.

For all of the above reasons, Applicants submit that the rejections of claims 1-22 and 34-36 over the various combinations of references, all of which depend upon at least Mikhael or Afzali-Ardakani with Porter, should be withdrawn.

As to the new rejection

Claim 36 is newly rejected under 35 USC § 103(a) as being unpatentable over JP 56026977 in view of Pohl '233, Renbaum '055 and Beratan '063. Applicants submit that the Examiner again fails to establish *prima facie* obviousness of the claimed invention.

The Examiner relies upon JP '977 to teach a combination of a viologen salt and a substrate (polystyrene). The reference is characterized as failing to teach that benzyl chloride groups can be grafted to the substrate other than a phenyl group-containing substrate. Applicants would further note that JP '977 does not appear to teach oxidative doping by any irradiation step. The objective of JP '977 is to prepare a photochromic coating comprising a viologen and a solid alcohol. The viologen changes color upon irradiation, a phenomenon arising from a change in oxidation state of the viologen. No polymer capable of exhibiting electrical conductivity upon oxidative doping is described in the JP '977 reference, nor is any change in electrical conductivity of any polymer.

The Examiner asserts that Pohl describes that irradiation of a substrate can be used to graft a vinyl benzyl chloride to a substrate other than a phenyl group-containing substrate. The Examiner's reliance upon Pohl is misplaced and so the rejection fails.

Pohl describes a grafting reaction driven by gamma irradiation. See, col. 8, line 18. The Examiner's position that ultraviolet radiation is a known substitute for gamma irradiation for grafting purposes is noted from the previous Office Action. However, the reaction driven by irradiation in the present invention is not a grafting reaction, but rather an oxidation of the polymer by the viologen salt. See, page 3, lines 7-10 and page 7, lines 10-14.

The mistake of the Examiner is clearly seen by the Examiner's description of Pohl as describing grafting to the polymer substrate. In the invention as embodied in claim 36, the irradiation step drives a reaction between the viologen salt-grafted film substrate (i.e. an already grafted substrate) and a polyaniline (i.e. a phenyl group containing) film.

Furthermore, even if *prima facie* obviousness of the claim is maintained, Applicants submit that, as explained above, the claimed invention provides unexpected results compared to the state of the art at the time the invention was made, as represented by Afzali-Ardakani. Such an unexpected result provides evidence of unobviousness of the invention sufficient to confer patentability over the cited references.

For all of the above reasons, the instant rejection should be withdrawn.


Applicants submit that the present application well-describes and claims patentable subject matter. Withdrawal of the standing rejections and allowance of the present claims is requested.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Mark J. Nuell (Reg. No. 36,623) at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

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